

THE MINERAL INDUSTRIES OF CAMBODIA AND LAOS

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CAMBODIA

Cambodia, which is located north of the Gulf of Thailand, south of Laos, southeast of Thailand, and southwest of Vietnam in Southeast Asia, is a small country with a total area of about 181,000 square kilometers (km²) or about the size of Missouri. In 2005, Cambodia had a population of 13.6 million. The country was one of the poorest and least developed in the Asia and the Pacific region. Its per capita gross domestic product (GDP) and GDP based on purchasing power parity were estimated to be \$2,116 and \$30.6 billion, respectively, in 2005 (International Monetary Fund, 2005§; U.S. Central Intelligence Agency, 2005§¹).

The country's mineral resources were largely untapped. The identified mineral resources were carbonate rocks, manganese, phosphate, ruby, salt, and zircon. Besides offshore natural gas and petroleum resources, Cambodia has geologic environments that have the potential to host resources of bauxite, coal, copper, gold, granite, iron ore, kaolin, lead, limestone, peat, sand and gravel, sapphire, silica sand, slate, tin, and zinc (World Investment News, 2004§).

To attract domestic and foreign mining companies to invest in mineral exploration and development, the Law of Minerals Management and Mining of Cambodia was promulgated by the Government on July 13, 2001 (United Nations, 2002§). The Ministry of Industry, Mines, and Energy (MIME) is the main Government agency that implements the law and the country's mineral policy. The Department of Geology and Mines and the Department of Energy under the MIME are responsible for developing the country's mineral resources, providing mining assistance to the private sector, and administering mining-related regulations and inspections (Asian Journal of Mining, 2000).

The mining sector, which according to Cambodian National Institute of Statistics was the smallest sector of the Cambodian economy, contributed only 0.27% to the country's GDP in 2004 (the latest year for which data were available) (National Institute of Statistics, 2005§). In 2005, Cambodia's real GDP was estimated to have grown by 6.3% compared with 7.7% (revised) in 2004. The country's GDP in current prices was \$5.4 billion compared with \$4.9 billion in 2004 (International Monetary Fund, 2005§).

According to Government official statistics, the mining activities in Cambodia during the past 2 years involved the production of laterite blocks (red soil) and construction materials, which included sands and crude stones. Other minerals, such as gemstones and gold, reportedly had been mined by illegal miners in the central Province of Kampong Cham, and the northeastern Provinces of Mondol Kiri and Rotano Kiri. In the past several years, illegal miners used highly toxic chemicals in gold mining that caused serious environmental damage to the Cambodian countryside and posed a health hazard. The official records, however, showed no gold production in Cambodia for the past 5 years.

At the 2005 Asia Mining Congress, the Cambodian Government revealed through the MIME that it would ask the World Bank to help finance a comprehensive mapping of the country's mineral resources. According to the MIME, before Cambodia opens its door for mining, the country must clear the areas rich in minerals of land mines and underground bombs left behind by almost 20 years of civil war following the 1979 fall of the Khmer Rouge. According to the MIME, to attract exploration companies, the Government reportedly approached Oxiana Ltd. of Australia and Asian Mineral Resources Ltd. of New Zealand, which were active in the Southeast Asia region. The Government reportedly had set a priority on developing bauxite, gold, and iron ore resources and planned to introduce stricter legislation to govern its mining sector. For example, small mines would be required to buy licenses, pay taxes, and adhere to environmental regulations. The Government also would extend the 2-year term of exploration licenses granted to prospectors. If a project reached mining stage, then a 7-year permit would be granted (Planetark.com, 2005§; Reuters Foundation AlertNet, 2005§).

In March 2005, two 2-year exploration licenses were awarded to a Cambodian-Chinese joint venture to explore for iron ore in Preah Vihear Province, and another was awarded to Delcom Cambodia Co. Ltd., which was partly owned by a Malaysian company, to explore for gold in Mondol Kiri Province. The Cambodian-Chinese joint venture comprised China National Machinery & Equipment Corp., Cambodia's Pheapimex Group, and Ratanak Stone Cambodia Development Co. Ltd., (People's Daily Online, 2005§; Reuters Foundation AlertNet, 2005§).

In June 2005, Cambodian Ventures Limited (CVL) of the United States announced that it had signed a definitive agreement to acquire gold exploration interests from Oksan Cambodia Corp. Under the agreement, CVL acquired an 85% interest in an 84-km² mineral exploration license in an area called Antrong in the Keo Seima District of Mondol Kiri Province, where Oksan reportedly had been working for more than 6 years. Based on its initial survey, Oksan estimated that the license area contains about 6.3 million metric tons (Mt) of gold-bearing ore. CVL was a junior mining company established in 1995 that initially focused on developing hydroelectric generation opportunities in Cambodia, but which in June 2004, shifted its focus to exploration and mining of precious minerals in Cambodia. In October 2005, CVL and Monterra Mining Inc. of Canada announced that they had entered into a joint-venture agreement for Monterra to invest up to \$1 million in mining projects in Cambodia. According to CVL, the funding commitment by Monterra would allow CVL to acquire more working interests in Cambodian precious minerals mines (Cambodian Ventures Ltd., 2005a§-c§).

Cambodia reported no proven reserves of natural gas and petroleum. Cambodia and Thailand had overlapping claims in an area of the Gulf of Thailand that covers about 27,000 km²; this area was thought to be rich in hydrocarbons. In 2002, the Cambodian National

¹References that include a section mark (§) are found in the Internet References Cited sections.

Petroleum Authority awarded Block A, which covers a 6,278-km² area in the overlapping claims area, to a consortium led by ChevronTexaco Corp. of the United States.

On January 12, 2005, ChevronTexaco announced that its affiliate, Chevron Overseas Petroleum (Cambodia) Ltd. (COPCL) (55%) and its partners, Japan's Mitsui Oil Exploration Co. (Moeco Cambodia) (30%) and the Republic of Korea's LG-Caltex Oil Corp. (15%), had discovered oil in four exploration wells in offshore Cambodia Block A, which is located about 130 kilometers (km) off the west coast of Cambodia. The 6,278-km² block encompasses the Khmer Basin, which has water depths that average 240 feet. A sample analysis indicated the oil is 44° API crude (Alexander's Gas & Oil Connections, 2005§; Chevron Corp., 2005§). According to the Cambodian National Petroleum Authority, the joint venture was studying the economic viability of the find, and COPCL was expected to drill six appraisal wells and four more exploration wells in early 2006. If the findings are positive, then oil production may begin as early as 2008 (Embassy of Cambodia in New Zealand, 2005§).

In April 2005, the X-Change Corporation of the United States was awarded oil and gas research and exploration rights to offshore Cambodia Blocks A and B by the Government of Cambodia. The X-Change Corporation's offshore block encompasses about 6,500 km² and is located about 200 km off the west coast of Cambodia. The offshore block covers about 1,500 km² in the northwest corner of Tonle Sap Basin. The Dallas, Texas-based oil and gas company and the Cambodian National Petroleum Authority had been working towards the joint-production agreement to explore and develop oil reserves in the Tonle Sap Basin (OilOnline.com, 2005§).

In August 2005, a joint venture led by PTTEP International Ltd. (30%) of Thailand (the project operator) and its partners SPC Cambodia (30%) (a subsidiary of Singapore Petroleum Company Limited), Resources Petroleum Limited (30%), and Cooper Energy Limited (10%) entered into an agreement with the Cambodian National Petroleum Authority to explore for oil and gas in offshore Block B, which is located 250 km off the coast of Cambodia to the east of the Thai-Cambodia overlapping claims area in the Gulf of Thailand. The block lies to the southeast of the Khmer Basin, where several oil and gas discoveries had been made. The 3-year exploration program would drill one exploration well and acquire 200 km² of three-dimensional seismic data (Rigzone.com, 2005§). In October 2005, Indocan Resources Inc. of the United States, which was a small Texas-based oil and gas exploration company, announced that it had filed applications with the Cambodian Government for the exploration rights to coastal areas and offshore areas of the country (Indocan Resources Inc., 2005§).

The Cambodian mining sector is expected to grow slowly as the gold and iron ore mines are developed and to begin ore production during the next 2 to 3 years; the sector is expected to remain small relative to other sectors of the Cambodian economy for the next 2 years, however, unless economically viable reserves of oil and natural gas in Block A being developed by ChevronTexaco begin to produce oil and gas by 2008. Cambodia's economy as measured by the GDP was forecasted to grow by 6.1% in 2006 (International Monetary Fund, 2005§).

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LAOS

Laos, which is located north of Cambodia, southeast of Burma, south of China, northeast of Thailand, and west of Vietnam in Southeast Asia, is a small landlocked country with a total area of about 237,000 km² or slightly larger than Utah. In 2005, it had a population of about 6.2 million. Laos was one of the poorest and least developed countries in the Asia and the Pacific region. In 2005, the per capita GDP and the GDP based on purchasing power parity were estimated to be \$2,049 and \$12.1 billion, respectively (International Monetary Fund, 2005§; U.S. Central Intelligence Agency, 2005§).

The identified mineral resources in Laos were barite, clays, coal, copper, dolomite, gold, graphite, gypsum, limestone, rock salt, sapphire, silver, tin, and zinc. Laos has geologic environments that have the potential to host such other resources as antimony, asbestos, bismuth, cobalt, iron ore, kaolin, lead, lignite, manganese, molybdenum, potash, silica sand, and tungsten. The country has geologic environments that are favorable for the discovery of coal, copper, gold, iron ore, potash, rock salt, and tin (Asian Journal of Mining, 2000).

According to the Ministry of Industry and Handicraft (MIH), because of the successful copper and gold projects of Australia's Oxiana and Pan Australian Resources Ltd. (formerly Pan Australian Resources N.L.) in Laos, more than 50 domestic and international companies were exploring for copper, iron ore, and zinc in Laos. Several companies from China and Vietnam—some of which had financial backing from North America and Europe—reportedly had applied for licenses to explore for iron ore and potash in Laos in 2005 (Planetark.com, 2005§).

Laotian real GDP growth in 2005 was estimated to be 7.3% compared with 6.4% in 2004 (International Monetary Fund, 2005§). The mining sector, which was dominated by the mining of copper, gold, gypsum, limestone, and tin, was becoming an important sector of the Laotian economy because of its increasing contribution to the country's GDP. As a result of increased output of copper, gold, and silver, the mining sector was estimated to have contributed more than 3% to the country's GDP in 2005 compared with an estimated 0.3% in 2004. According to the MIH, the mining sector accounted for about one-third of Laotian industrial earnings, which in turn contributed about 26% of the Laotian GDP. According to a media report in 2005, gold production alone accounted for 2.4% of the Laotian GDP in 2004 (Oxiana Ltd., 2005b§; Planetark.com, 2005§).

In 2005, production of mineral commodities in Laos included barite, carbonate rocks (construction aggregate and limestone), clay, coal, copper, gemstones (ruby and sapphire), gold, gypsum, rock salt, sand and gravel, silver, tin, and zinc (table 1). Coal, copper, gold, gypsum, and zinc were the major mineral commodities produced in 2005. Coal was produced by the State Coal Mining Enterprise from the Chskeui Mine in Salavan Province, the Hongsa Mine in Sayaboury Province, and the Vieng Poukha Mine in Luangnamtha Province. Copper and gold were produced by Oxiana from its Sepon gold project at Sepon open pit and at the Khanong pit near the town of Sepon in Savannakhet Province and by Pan Australian Resources from its Phu Bia project north of Vientiane, which is the national capital of Laos. Gypsum was produced by the State Gypsum Enterprise from the Dong Hene Mine in Savannakhet Province. Zinc was produced by the joint venture of the Laotian Government and Thai Padaeng Industry Public Co. Ltd. from Kaiso Mine in Vang Vien, Vientiane Province, and by First Pacific Mining Company from the Pha Luang Mine, which is also located in Vang Vien.

For the first time in its modern history, Laos joined the ranks of the world's copper producers, with the first cathode copper produced from Oxiana's Sepon project in March 2005. The project's 60,000-metric-ton-per-year (t/yr) copper-processing plant, which is located about 3 km south of the Khanong pit and uses Outokumpu Technology's solvent extraction-electrowinning process, was completed by Outokumpu Technology (which was part of Outokumpu Group) in February 2005. The production of cathode copper began on March 14, which was two weeks ahead of schedule, and the first load of 60 metric tons (t) of Laotian copper was shipped to Thailand at the end of March 2005. According to Oxiana, the Sepon copper plant processed 1.3 Mt of ore and produced 30,480 t of cathode copper in 2005 as planned and was expected to produce 60,000 t in 2006. Oxiana planned to sell Sepon's copper to cable, tube, and wire manufacturers in China Malaysia, Taiwan, Thailand, and Vietnam (Oxiana Ltd., 2005a§, c§).

Copper exploration conducted by Oxiana at the Thengkham North and the Thengkham South deposits during 2004 and 2005 resulted in the discovery of additional resources of about 29.4 Mt of ore at a grade of 1.5% copper at the Thengkham North deposit and about 25 Mt of ore at a grade of 1.3% copper at the Thengkham South deposit. The resources at the Khanong deposit, predominantly a chalcocite ore body, were estimated to be 42 Mt of ore at a grade of 3.0% copper. In early 2005, the company made plans to expand its copper operation following the discovery of additional resources at the Thengkham North and the Thangkham South deposits and initiated a study in the third quarter of 2005 to assess the feasibility of copper plant expansion (Oxiana Ltd., 2005a§, c§).

Pan Australian Resources, which was expected to become the second copper producer in Laos, appointed Ausenco Ltd. as lead consultant to conduct the full bankable feasibility study for its Phu Kham copper-gold project in December 2004. The infill drill program conducted by the company in the central area of the deposit supported a resource upgrade at the Phu Kham copper-gold project. The feasibility study, which was scheduled for completion in March 2006, was seeking to confirm the potential for the Phu Kham copper-gold project to support a 9-million-metric-ton-per-year (Mt/yr) flotation operation to produce an average of 50,000 t/yr of copper and 1,608 kilograms per year (kg/yr) of gold in a concentrate with total capital expenditures of about \$195 million. As of October 2005, the Phu Kham copper-gold mineral resource was estimated to be 160.1 Mt at a grade of 0.66% copper and 0.29 g/t gold. Under Phu Kham Phase II, the Phu Kham copper-gold project was scheduled for commissioning at the end of 2007 and full production was expected to start in mid-2008 (Pan Australian Resources Ltd., 2005a§, c§; 2006§).

In 2005, gold mine production was mainly by Oxiana from its Sepon gold mine. In 2005, the Sepon Mine produced about 3.1 Mt of ore at a grade of 2.59 grams per metric ton (g/t) gold compared with 2.5 Mt at a grade of 3.01 g/t in 2004. The mill processed 2.66 Mt of ore at grades of 2.77 g/t gold and 4.99 g/t silver compared with 1.38 Mt of ore at grades of 3.77 g/t gold and 6.33 g/t silver in 2004. The recovery rate for gold and silver was 84.5% and 25.6%, respectively, in 2005, compared with 85.4% and 31.3%, respectively, in 2004. In 2005, the production of gold and silver from the Sepon gold mine was 6,232 kilograms (kg) (200,370 troy ounces) and 3,405 kg (109,460 troy ounces), respectively, compared with 4,392 kg (141,213 troy ounces) and 2,735 kg (87,920 troy ounces), respectively, in 2004. The total cash cost rose to \$8,359 per kilogram (\$260 per troy ounce) from \$6,076 per kilogram (\$189 per troy ounce) in 2004. The higher cash cost in 2005 was caused mainly by a temporary shutdown of SAG ball mill, lower gold recovery, and the higher cost of supplies. The total production costs (cash cost plus depreciation, depletion, amortization, and rehabilitation) rose to \$11,092 per kilogram (\$345 per troy ounce) from \$9,034 per kilogram (\$281 per troy ounce) in 2004 (Oxiana Ltd., 2005a§).

In December 2004, Oxiana reportedly had entered into an exploration joint venture with South Africa-based AngloGold Ashanti Ltd. (the world's second ranked producer of the precious metal) to explore for gold throughout Laos (AngloGold Ashanti Ltd., 2004§; Seven Corporate, 2005§). During 2005, Oxiana continued to carry out its Sepon gold exploration program at the Luang and the Discovery Main deposits and at the Ban Mai, the Houay Bang, the Kengkeuk, and the Pha Vat North Prospects. According to Oxiana, near mine exploration continued to confirm the potential for greater gold and copper resources, and its resource development drilling continued to find additional oxide resources in the Discovery West, the Nalou, and the Namkok West areas, which are located within 3 to 4 km of Oxiana's gold and copper plants (Oxiana Ltd., 2005a§).

Pan Australian Resources became the second Laotian gold producer in 2005 when the company poured gold from the Phu Bia heap leach mine on November 1, 2005. The gold production for the two months that ended on December 31, 2005, totaled 106.3 kg (3,418 troy ounces). According to Pan Australian Resources, the Phu Bia heap leach gold mine was on schedule to produce more than 1,900 kg (60,000 troy ounces) at cash costs of about \$200 per ounce in 2006. At the Phu Bia heap leach gold mine (Phu Kham gold cap under the Phu Kham Phase I), the oxide mineral resource was estimated to be 12.8 Mt at a grade of 1.0 g/t gold, of which the oxide ore reserve was estimated to be 8.6 Mt at a grade of 1.1 g/t gold. The preproduction capital cost was \$15.3 million. The company planned to mine 2 Mt of ore with a head grade of 1.5 g/t gold and a 90% recovery rate to produce about 1,900 kg (60,000 troy ounces) of gold in 2006 (Pan Australian Resources Ltd., 2006§).

In December 2005, Pan Australian Resources announced that it had completed acquisition of Newmount's 20% interest in Phu Bia Mining Ltd. for \$5.3 million following approval of the share transfer by the Laotian Government. The Government had indicated that it will exercise its option to acquire a 10% interest in Phu Bia Mining. After the Government has exercised its option, Pan Australian Resources will own a 90% interest in Phu Bia Mining and thereby have a 90% interest in the Phu Bia gold mine and the Phu Kham copper-gold project (Pan Australian Resources Ltd., 2005b§).

First Pacific Mining Company, which signed a contract with the Laotian Government in 2003, reportedly started to mine and process lead and zinc at the Pha Luang Mine near Vang Vien, Vientiane Province, for export to China. In April 2005, Rox Resources Ltd. of Australia (a Perth-based exploration company) reached an agreement with First Pacific Mining (Laos) Company Ltd. to acquire a 60% interest in the sulfide portion of the Pha Luang lead-zinc and silver mine (Rox Resources Ltd., 2005b§). Rox Resources' exploration drillings started in June 2005 and were conducted in the Bon Noi, the Nam Yen, the Pha Luang 2, and the Pha Luang 3 prospects, which are located approximately 160 km north of Vientiane. According to Rox Resources' Managing Director, the returned results indicated that the Pha Luang has potential to host a significant lead-zinc ore body. In September 2005, Rox Resources planned aggressive exploration programs at the Bon Noi and the Nam Yen prospects. Additional exploration was to be conducted from December 2005 to May 2006 (Rox Resources Ltd., 2005a§).

During the next 3 years, the mining sector is expected to expand considerably. Oxiana is expected to increase its copper and gold production capacity at its Khanong copper mine. Production capacities for copper and gold could be boosted by Pan Australian Resources if the development of the Phu Kham copper-gold project and the Phu Bia gold project are completed and come onstream by 2008. During the next 5 to 6 years, Chinese investment potential in the mining sector may include potash production in Vientiane, development of iron ore deposits in Xiengkhuang Province, and planned hydroelectric power development in the Nam Ngum River northeast of Vientiane in Xiengkhuang Province.

The World Bank reportedly had approved financing support for a \$1.2 billion dam project in April 2005. The power generated from the Nam Theum 2 Dam would be sold to Thailand and the revenues would be used for education, health, and other antipoverty initiatives. The project would be funded by \$855 million in loans and by \$330 million in equity from shareholders, which included the Laotian Government and companies from France and Thailand. According to The Wall Street Journal, the World Bank was expected to provide a \$20 million grant, a \$50 million loan, a partial risk guarantee, and a \$200 million Multilateral Investment Guarantee Agency loan guarantee. Other multilateral organizations also were expected to assist the project (Wall Street Journal, The, 2005).

The Laotian economy was expected to grow by 7% in 2006 (International Monetary Fund, 2005§). The economy will expand further if the country's mining sector increases its contribution to the country's GDP through increased production and exports of copper, gold, silver, and zinc during the next 3 to 4 years.

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TABLE 1
CAMBODIA AND LAOS: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Country and commodity	2001	2002	2003	2004	2005 ^c
CAMBODIA²					
Gravel	1,880	9,800	13,800	-- ^r	--
Laterite, blocks	42,800	381,400	240,700 ^r	118,400 ^r	200,000
Phosphate fertilizer	900	115	--	--	--
Quartz sand	5,050	--	1,000	--	--
Salt	11,000	72,500	36,000	40,000 ^c	40,000
Sand, construction materials	563,860	505,960	248,400 ^r	358,700 ^r	400,000
Stones, crude construction materials	280,740	642,500 ^r	786,100 ^r	501,600 ^r	600,000
LAOS³					
Barite	3,300 ^r	12,695	18,070	10,470 ^r	15,000
Cement ^c	92,000	240,000	250,000	250,000	350,000
Clay	41,577	117,572	51,866	58,718	60,000
Coal, lignite	177,106 ^r	233,923	212,819	298,761 ^r	300,000
Copper, refined	--	--	--	--	30,480 ⁴
Gemstones, sapphire	carats 532,494	833,984	2,302,973	712,320 ^r	800,000
Gold	kilograms --	--	5,368	4,392 ^r	6,338 ⁴
Gravel	331,200	559,000	549,300	98,900	120,000
Gypsum	121,220	110,272	101,727	244,145 ^r	250,000
Limestone	472,652 ^r	1,315,140	379,000	518,000	560,000
Salt, rock	2,635	5,410	16,130	15,000 ^c	15,000
Sand, construction materials	331,200	559,000	549,300	98,900	100,000
Silver	kilograms --	--	3,850	2,735 ^r	3,405 ⁴
Tin, mine output, Sn content ^c	490	366	360	400 ^r	450
Zinc, mine output, Zn content ^c	9,310	370	850	950 ^r	1,100

^cEstimated; estimated data are rounded to no more than three significant digits. ^rRevised. -- Zero.

¹Table includes data available through March 24, 2006.

²In addition to the commodities listed, clay, gemstones, gold, iron ore, and lime are presumably produced, but available information is inadequate to make reliable estimates of output levels.

³In addition to the commodities listed, crude construction materials, such as sand and gravel, and varieties of stone were produced irregularly.

⁴Reported figure.

Sources: Cambodia's Ministry of Industry, Mines and Energy; Laos' Ministry of Industry and Handicraft, Lao PDR 2004 Mineral Yearbook; U.S. Geological Survey Minerals Questionnaires for Cambodia (2002-04) and Laos (2002-03); Oxiana Ltd. Annual Report 2004 and Quarterly Reports 2004-05; Pan Australian Resources Ltd., Quarterly Reports 2005.